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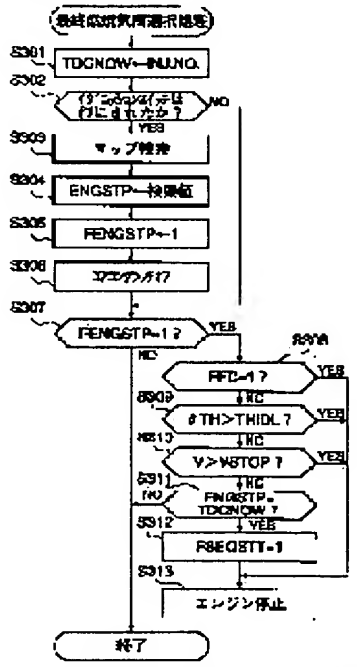
(54) STOP POSITION CONTROL DEVICE FOR INTERNAL COMBUSTION ENGINE

(57)Abstract:
PROBLEM TO BE SOLVED: To enhance exhaust gas characteristics at the time of engine starting without impairing startability.
SOLUTION: In this control device, when an engine ignition switch is turned off, a specific value ENGSTP is obtained (step S303 and S304), which specifies a final combustion cylinder in which final combustion takes place, in response to engine revolutions and pressure within an intake pipe, fuel supply and ignition control are kept on until the specific value ENGSTP agrees with a present value register TDCNOW, when both of them agree with each other, an engine operation is suspended (step S311 and S13). By this constitution, a crank shaft is suspended at a position where for example, #2 CYL is in the upper dead center of an intake stroke.



LEGAL STATUS

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CLAIMS

[Claim(s)]
[Claim 1] In the halt positional controller of the internal combustion engine which has an operational status detection means to detect an internal combustion engine's operational status, and the control means which performs control of the fuel supply to said engine, and control of ignition according to this operational status A switch detection means to detect the on-off condition of an ignition switch, and when said ignition switch is turned OFF, It is based on the operational status detected by said operational status detection means. The halt positional controller of the internal combustion engine characterized by having the engine halt control means which said control means is carried out [engine] and stops either [at least] said fuel supply or ignition so that said engine's crankshaft may stop in a predetermined crank angle location.
[Claim 2] Said engine halt control means is the halt positional controller of the internal combustion engine according to claim 1 characterized by having a cylinder selection means to choose the cylinder which should burn a fuel at the end.
[Claim 3] Said predetermined crank angle location is a halt positional controller of the internal combustion engine according to claim 1 or 2 characterized by being the location which has a specific cylinder in said engine in an abbreviation intake-stroke top dead center.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] About an internal combustion engine's halt positional controller, especially this invention makes suitable fuel-injection control at the time of engine start up, and relates to the halt positional controller of the internal combustion engine which aimed at improvement in startability and an exhaust gas property.
[0002]
[Description of the Prior Art] Generally an actuation halt of an internal combustion engine is made by turning OFF an ignition switch. If an ignition switch is turned OFF, the fuel supply to an engine and ignition to an ignition plug are stopped, and an engine's crankshaft will stop, after rotating by inertia.
[0003] Moreover, after the cylinder which an engine's crankshaft has stopped in which crank angle location at the time of engine start up of the former and next time, or should perform fuel injection about all cylinders at first (it injects at the time of **), and a crankshaft should rotate two times since the initial position is usually unknown, and then should be injected is distinguished by the cylinder signal pulse etc., the fuel-injection control approach which was made to shift to sequential injection of normal is learned (for example, JP,63-14174,B). According to this technique, an engine's startability is securable irrespective of the initial position of the crankshaft at the time of start up.
[0004]
[Problem(s) to be Solved by the Invention] However, by the above-mentioned conventional fuel-injection control approach, since it does not ask in which stroke each cylinder is by injection at the time of ** at the time of engine start up but simultaneous injection of the fuel is uniformly carried out to each cylinder, the fuel injection in a stroke or timing optimal about all cylinders becomes impossible. Therefore, it compared, when fuel injection was carried out to a stroke or timing optimal about each cylinder like sequential injection, and there was a problem that the discharge of HC at the time of engine start up (hydrocarbon) increased by the nonflammable glow of a fuel etc.
[0005] It is made in order that this invention may solve the problem of the above-mentioned conventional technique, and the object is in offering the halt positional controller of the internal combustion engine which can aim at improvement in the exhaust gas property at the time of engine start up, without spoiling startability.
[0006]
[Means for Solving the Problem] In order to attain the above-mentioned object the halt positional controller of the internal combustion engine of claim 1 of this invention In the halt positional controller of the internal combustion engine which has an operational status detection means to detect an internal combustion engine's operational status, and the control means which performs control of the fuel supply to said engine, and control of ignition according to this operational status A switch detection means to detect the on-off condition of an ignition switch, and when said ignition switch is turned OFF, Based on the operational status detected by said operational status detection means, it is characterized by having the engine halt control means which said control means is carried out [engine] and stops either [at least] said fuel supply or ignition so that said engine's crankshaft may stop in a predetermined crank angle location.
[0007] By this configuration, an internal combustion engine's operational status is detected, according to this operational status, control of the fuel supply to said engine and control of ignition are performed, and the on-off condition of an ignition switch is detected. And based on said detected operational status, when said ignition switch is turned OFF, one [at least] halt of said fuel supply and ignition is made so that said engine's crankshaft may stop in a predetermined crank angle location.

[0008] Although said crankshaft rotates from habit also after a combustion halt of an engine, one [at least] halt of said fuel supply and ignition is made in that case so that said engine's crankshaft may stop in a predetermined crank angle location. Therefore, since the initial position of the crankshaft at the time of start up fixed-izes, the fuel-injection processing at the time of start up can be appropriately started by sequential injection, without spoiling startability, buildup of the discharge of HC at the time of engine start up can be prevented, and improvement in an exhaust gas property can be aimed at.
[0009] Moreover, as for said engine halt control means, it is desirable to have a cylinder selection means to choose the cylinder which should burn a fuel at the end.
[0010] Since said crankshaft stops by this configuration in the always same crank angle location when a fuel burns at the end in said selected cylinder, the initial position of the crankshaft at the time of start up fixed-izes. Therefore, the fuel-injection processing at the time of start up can be appropriately started by sequential injection, without spoiling startability, buildup of the discharge of HC at the time of engine start up can be prevented, and improvement in an exhaust gas property can be aimed at.
[0011] Moreover, as for said predetermined crank angle location, it is desirable that it is the location which has a specific cylinder in said engine in an abbreviation intake-stroke top dead center.
[0012] Since the cylinders of enough which should be injected by the next degree of said specific cylinder are in a front phase from an intake-stroke initiation event in the initial position at the time of engine start up and the optimal timing for fuel injection visits first by this configuration, sequential injection can be promptly started from the cylinder which should be injected by the following degree concerned.
[0013]
[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained with reference to a drawing.
[0014] Drawing 1 is drawing showing the whole stop control configuration of the internal combustion engine concerning the gestalt of 1 operation of this invention. One is the internal combustion engine (only henceforth an "engine") of a serial 4-cylinder among this drawing.
[0015] A throttle body 3 is formed in the middle of the inlet pipe 2 of an engine 1, and throttle-valve 3' is allotted to the interior. Moreover, the sensor 4 is connected with throttle-valve 3' whenever [throttle valve-opening] (thetaTH), the electrical signal according to the opening of throttle-valve 3' is outputted, and the electronic control unit (henceforth "ECU") 5 is supplied.
[0016] A fuel injection valve 6 is electrically connected to ECU5 while connecting with the fuel pump which between an engine 1 and throttle-valve 3' and an inlet pipe 2 do not illustrate, and the valve-opening time amount of fuel injection is controlled by the signal from ECU5 concerned.
[0017] Moreover, a branch pipe 7 is formed in the downstream of throttle-valve 3' of an inlet pipe 2, and the inlet-pipe internal pressure (PB) sensor 8 is attached at the head of this branch pipe 7. This PB sensor 8 is electrically connected to ECU5, and the inlet-pipe internal pressure PB is changed into an electrical signal by said PB sensor 8, and is supplied to ECU5.
[0018] Moreover, the tube wall of the inlet pipe 2 of the downstream of a branch pipe 7 is equipped with the intake-air temperature (TA) sensor 9, and the intake-air temperature TA detected by this TA sensor 9 is changed into an electrical signal, and is supplied to ECU5.
[0019] The engine water temperature (TW) sensor 10 which consists of a thermistor etc. is inserted in the cylinder peripheral wall with which the cooling water of the cylinder block of an engine 1 was filled, and engine-cooling-water ** TW detected by this TW sensor 10 is changed into an electrical signal, and is supplied to ECU5.
[0020] Moreover, the cylinder distinction (CYL) sensor 11, the TDC sensor 12, and the crank angle (CRK) sensor 13 are attached in the predetermined location of the cam shaft perimeter which an engine 1 does not illustrate, or the perimeter of a crankshaft, respectively.
[0021] The CYL sensor 11 outputs a pulse signal (henceforth a "CYL signal pulse") whenever [predetermined crank angle / of a specific cylinder] every crankshaft 2 revolution in a location, and supplies this CYL signal pulse to ECU5.
[0022] the inhalation line of each cylinder of an engine 1 outputs [whenever / predetermined crank angle] a signal pulse (henceforth a "TDC signal pulse") whenever [front crank angle] about the top dead center (TDC) at the time of initiation in a location (a 4-cylinder engine -- 180 degrees of every crank angles), and the TDC sensor 12 supplies this TDC signal pulse for it to ECU5.
[0023] The CRK sensor 13 outputs a pulse signal (henceforth a "CRK signal pulse"), the period (for example, period of 30 degree), i.e., the fixed crank angle period shorter than 180 degrees, of a TDC signal pulse, and supplies this CRK signal pulse to ECU5.

[0024] The ignition plug 14 of each cylinder of an engine 1 is electrically connected to ECU5, and ignition timing is controlled by ECU5.
[0025] Moreover, in the middle of the exhaust pipe 17 of an engine 1, the broader-based oxygen density sensor (a "LAF sensor" is called hereafter) 18 is formed, and the oxygen density in the exhaust gas detected by this LAF sensor 18 is changed into an electrical signal, and is supplied to ECU5.
[0026] The speed sensor 15 which detects the vehicle speed V is attached in speed sensor 15 wheel (not shown), and the vehicle speed V detected by this speed sensor 15 is changed into an electrical signal, and is supplied to ECU5. Moreover, the signal which shows the on position of an ignition switch 16 is supplied to ECU5.
[0027] Input circuit 5a which has the function of ECU5 operating the input signal wave from various above-mentioned sensors orthopedically, correcting a voltage level to predetermined level, and changing an analog signal value into a digital signal value, Storage means 5c which consists of ROM and RAM which memorize various maps [program / operations / various / and] mentioned later, the result of an operation, etc. which are performed by central data-processing circuit (henceforth "CPU") 5b, and this CPU5b, Said fuel injection valve 6 and ignition plug 14 are equipped with 5d of output circuits which supply a driving signal.
[0028] ECU5 computes an engine speed NE by measuring the recurrence interval of a TDC signal pulse. Moreover, ECU5 detects [whenever / criteria crank angle / of each cylinder] Stage STG (henceforth a "stage") based on a TDC signal pulse and a CRK signal pulse whenever [from a location / crank angle].
[0029] ECU5 is equipped with a capacitor or a delay timer, and even after turning OFF an ignition switch 16 by these, it is constituted for several seconds so that actuation can be continued.
[0030] While CPU5b distinguishes the operational status of various engines according to the oxygen density in exhaust gas, such as a feedback control operating range and an open loop control operating range, based on various above-mentioned engine parameter signals In the case of a basic mode, according to engine operational status, it is based on the following formula 1. Moreover, in the case of starting mode, the fuel injection duration TOUT of the fuel injection valve 6 which synchronizes with a TDC signal pulse based on the following formula 2 is calculated in each cylinder (#1-#4CYL) of every, and it memorizes the result to storage means 5c (RAM).
[0031]
[Equation 1] TOUT=TiMxKCMDMxKLAFxK1+K2+TV [0032]
[Equation 2] TOUT=TiCRxK3+K4+TV -- the TiM map for TiM(s) being the basic fuel quantity at the time of a basic mode and basic fuel injection duration specifically set up according to an engine speed NE and the inlet-pipe internal pressure PB, and determining this TiM value here is memorized by storage means 5c (ROM).
[0033] TiCR is the basic fuel quantity at the time of starting mode, like the TiM value, it is set up according to an engine speed NE and the inlet-pipe internal pressure PB, and the TiCR map for determining this TiCR value is memorized by storage means 5c (ROM).
[0034] KCMDM is a correction target air-fuel ratio multiplier, and is set up according to engine operational status.
[0035] KLAF is an air-fuel ratio correction factor, during feed back control of air-fuel ratio, it is set up so that the air-fuel ratio detected by the LAF sensor 18 may be in agreement with a target air-fuel ratio, and it is set as the predetermined value according to an engine operation condition during open loop control.
[0036] K1, K2, K3, and K4 are the correction factors and amendment variables which are calculated according to various engine parameter signals, respectively, and they are set as a predetermined value with which optimization of many properties, such as a fuel consumption property, an acceleration property, etc. according to an engine operation condition, is attained for every cylinder.
[0037] TV is the invalid time amount of a fuel injection valve 6, and shows a time delay until a fuel injection valve 6 opens after energization initiation.
[0038] ECU5 constitutes an operational status detection means, a control means, a switch detection means, an engine halt control means, and a cylinder selection means.
[0039] Drawing 2 is drawing showing an injection stage timing chart. This drawing (a) shows the timing like the inhalation line of each cylinder (#1-#4CYL), and the injector number ("INJ.NO" is called below) corresponding to it. For example, INJ.NO in case the 2nd cylinder (#2CYL) is in an intake stroke is "3." At the event t, #2CYL is in an intake-stroke top dead center.
[0040] This drawing (b) As for - (e), as for the inhalation line in each cylinder, (A), a compression stroke (B), and an explosion line show the timing of each stroke of (C) and an exhaust stroke (D). This drawing

(b), (c), (d), and (e) show the 1st cylinder (#1CYL), the 2nd cylinder (#2CYL), the 3rd cylinder (#3C YL), and the 4th cylinder (#4CYL), respectively. Usually, in sequential injection of the fuel at the time, after a cylinder is distinguished by the CYL signal pulse, a fuel is injected in order of --, #1CYL and #3C YL, #4CYL, #2CYL, #1CYL, and --.

[0041] Drawing 3 is drawing showing the flow chart of the last combustion cylinder selection processing. This processing is performed for every generating of a TDC signal pulse.

[0042] First, INJ.NO (integral value of either 0-3) equivalent to the cylinder in which the fuel was injected by the current value register TDCNOW just before OFF of an ignition switch 16 is set up (step S301), and it distinguishes whether the ignition switch 16 was turned OFF (step S302). When the ignition switch 16 is not turned OFF, while progressing to step S307 promptly as a result of the distinction, when an ignition switch 16 is turned OFF, map retrieval according to the operational status of an engine 1 is performed (step S303).

[0043] It is drawing showing the last combustion cylinder selection map in drawing 4 . In order to make it the crankshaft of an engine 1 stop in a predetermined crank angle location (at for example, the event of the location and drawing 2 which have #2CYL in an intake-stroke top dead center (t)), this map is a map for determining whether it is appropriate to burn a fuel at the end in which cylinder, and is set up by the integral value (0-3) by making the value corresponding to that suitable cylinder into search values. These search values are set up considering an engine speed NE and the inlet-pipe internal pressure PB as a parameter.

[0044] Return and the last combustion cylinder specification value ENGSTP which subsequently specifies the last combustion cylinder are set as the search values by which retrieval was carried out [above-mentioned] at drawing 3 (step S304), the engine shutdown flag FENGSTP which shows by "1" what an engine 1 should be stopped for is set as "1" (step S305), an air-conditioner clutch is turned OFF (step S306), and it progresses to step S307. Here, an air-conditioner clutch is turned OFF because the load of an air-conditioner influences the amount rotated by the inertia of a crankshaft. Therefore, if there are devices which give a load to an engine 1 except an air-conditioner, it is desirable to process to turn off those clutches similarly etc.

[0045] Subsequently, at step S307, it distinguishes whether the engine shutdown flag FENGSTP is set as "1." When the engine shutdown flag FENGSTP is not set as "1", while ending this processing promptly as a result of the distinction When the engine shutdown flag FENGSTP is set as "1" It distinguishes whether the flag FFC which shows by "1" that it is [fuel] under cut is set as "1" (step S308). When Flag FFC is not set as "1" as a result of the distinction thetaTH distinguishes whether it is larger than the predetermined value THIDL which shows whenever [throttle valve-opening / at the time of an idle] whenever [throttle valve-opening] (step S309). When it is thetaTH<=THIDL as a result of the distinction, the vehicle speed V is larger than the predetermined value VSTOP (for example, 5 km/h), or distinguishes no (step S310).

[0046] When it is V<=VSTOP as a result of distinction of said step S310 It distinguishes whether the last combustion cylinder specification value ENGSTP and the current value register TDCNOW were in agreement (step S311). When the last combustion cylinder specification value ENGSTP and the current value register TDCNOW are not in agreement, while ending this processing promptly as a result of the distinction, when both are in agreement The flag FSEQSTT which shows by "1" that the fuel-injection processing at the time of next start up can be started by sequential injection from #3C YL and which can be sequential injected is set as "1" (step S312), and halt processing of an engine 1 is performed (step S313). That is, ECU5 suspends the control action, without performing the following fuel injection and the ignition control to a cylinder. Thereby, the crankshaft of an engine 1 always stops in the location which has #2CYL in an intake-stroke top dead center.

[0047] On the other hand, when Flag FFC is set as "1" at said step S308 (under a fuel cut) and it is thetaTH>THIDL at said step S309 (it is not an idle state), or when it is V>VSTOP at said step S310 (a car is not a idle state), all perform step S313 promptly.

[0048] According to this processing, in case an engine 1 is stopped, those control is continued until it is carried out about the cylinder as which the cylinder which should be burned at the end was chosen as according to operational status (an engine speed NE and inlet-pipe internal pressure PB) (steps S303 and S304), and fuel supply and control of ignition were chosen (step S311).

[0049] Drawing 5 is drawing showing the flow chart of the crank processing in starting mode, and this processing is performed at the time of ON of an ignition switch 16.

[0050] First, it distinguishes whether the flag FSEQSTT which can be sequential injected is set as "1" (step S501). When the flag FSEQSTT which can be sequential injected is set as "1" as a result of the distinction # Start fuel-injection processing by sequential injection from 3C YL (cylinder) (step S502). While ending this processing, when the flag FSEQSTT which can be sequential injected is not set as "1", fuel-injection

processing is started by injection at the time of ** (step S503), and this processing is ended.
[0051] When the initial position of the crankshaft of an engine 1 has become clear as a location which has #2CYL in an intake-stroke top dead center according to this processing, sequential injection can be performed promptly and sequential injection can be performed from the cylinder which is moreover in the optimal stroke. Therefore, it can compare, when injecting uniformly at the time of start up at the time of **, and the discharge of HC can be reduced, and startability is not spoiled.
[0052] As explained above, in case an engine 1 is stopped according to the gestalt of this operation, the cylinder which should be burned at the end is chosen according to operational status (an engine speed NE and inlet-pipe internal pressure PB) (steps S303 and S304), and fuel supply and control of ignition are made by the last about the selected cylinder (step S311). Therefore, since the crankshaft of an engine 1 always stops in a predetermined crank angle location (location which has #2CYL in an intake-stroke top dead center), the initial position of the crankshaft at the time of next start up fixed-izes. Therefore, without being able to perform sequential injection promptly appropriately and spoiling startability at the time of next start up, buildup of the discharge of HC at the time of engine start up can be prevented, and an exhaust gas property can be improved.
[0053] In addition, with the gestalt of this operation, finally, the selected cylinder may not be restricted to this, although it was made to suspend the both sides of fuel supply and ignition, and you may carry out as [stop / either].
[0054] In addition, the crank angle location which stops a crankshaft is not restricted to the location which has #2CYL mentioned above in an intake-stroke top dead center, and you may make it stop a crankshaft in the location of one crank angle stage of one of the cylinders. In this case, what is necessary is just to set up the cylinder which should inject a fuel first at the time of next start up according to the crank angle location which a crankshaft stops.
[0055]
[Effect of the Invention] As explained above, according to the halt positional controller of the internal combustion engine concerning claim 1 of this invention In the halt positional controller of the internal combustion engine which has an operational status detection means to detect an internal combustion engine's operational status, and the control means which performs control of the fuel supply to said engine, and control of ignition according to this operational status A switch detection means to detect the on-off condition of an ignition switch, and when said ignition switch is turned OFF, Since it has the engine halt control means which said control means is carried out [engine] and stops either [at least] said fuel supply or ignition based on the operational status detected by said operational status detection means so that said engine's crankshaft may stop in a predetermined crank angle location Improvement in the exhaust gas property at the time of engine start up can be aimed at without spoiling startability.
[0056] According to the halt positional controller of the internal combustion engine concerning claim 2, since it has a cylinder selection means to choose the cylinder which should burn a fuel at the end, said engine halt control means can aim at improvement in the exhaust gas property at the time of engine start up, without spoiling startability.
[0057] According to the halt positional controller of the internal combustion engine concerning claim 3, since the specific cylinder in said engine is a location in an abbreviation intake-stroke top dead center, said predetermined crank angle location can start sequential injection promptly from the cylinder which should be injected by the following degree concerned.

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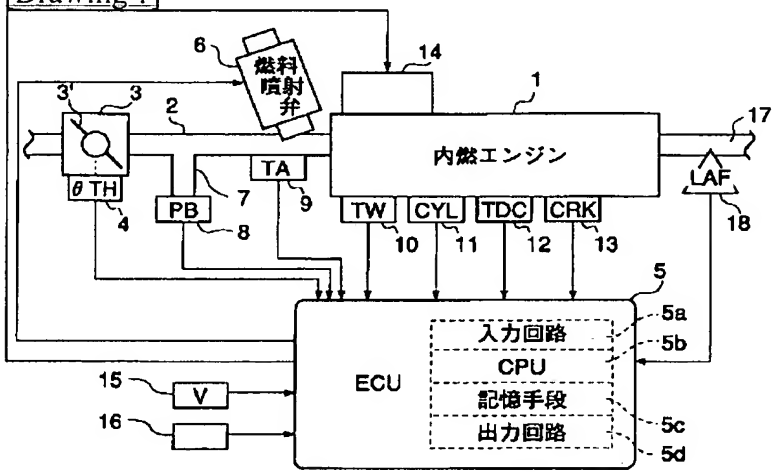
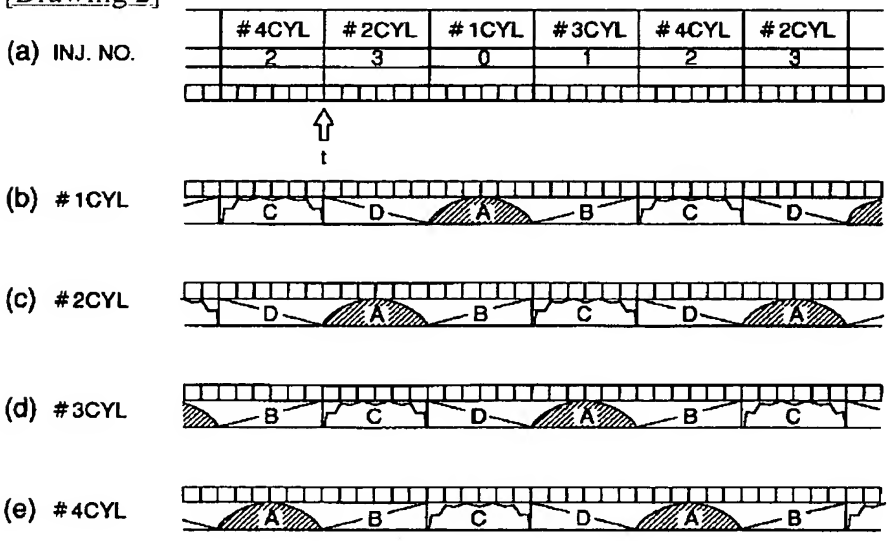
DRAWINGS

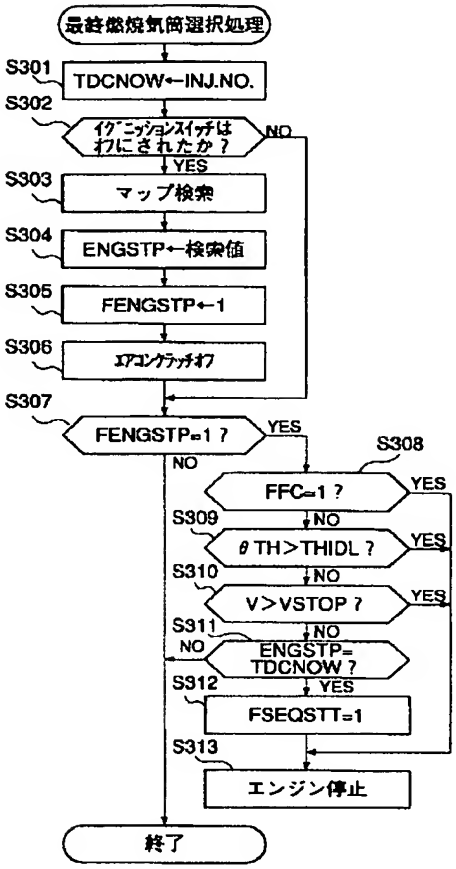
[Drawing 1]



[Drawing 2]



[Drawing 3]

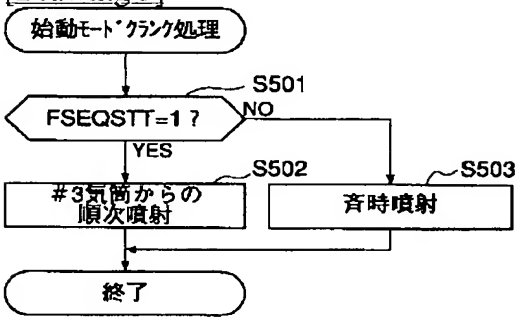


[Drawing 4]

(rpm)

(mmHg) PB \ NE	600	800	1000
-560	3	0	1
-310	3	0	1
0	3	0	1

[Drawing 5]



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